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Persistence of Western Hemlock and Western Redcedar Trees 38 Years After Girdling at Cat Island in Southeast Alaska

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Abstract

Dead western hemlock (*Tsuga heterophylla* (Raf.) Sarg.) and western redcedar (*Thuja plicata* Donn ex. D. Don) trees were examined 38 years after intentional girdling (cuts made into wood around the bole) at Cat Island, Alaska, to describe their condition as wildlife habitat. All but 1 of 42 hemlock had boles broken at or below 30 feet. The wood of all standing boles and boles on the forest floor was thoroughly degraded by brown rot fungi, white rot fungi, or both. Western redcedar snags were either standing with primary limbs intact, or were down with boles broken at the girdle. Snags of neither species had cavities excavated by animals. Although only four Sitka spruce (*Picea sitchensis* (Bong.) Carr.) were killed in the study, two were still standing, both having been extensively used by cavity excavating animals. Dead hanging bark of all three tree species may provide roosting habitat for bats.

Keywords: Dead tree, snag, western hemlock, western redcedar, cavity, wildlife, Alaska.

Introduction

Twelve species of birds rely on tree cavities for roosting and nesting in southeast Alaska (Hughes 1985). Information on how long dead trees (snags) of different species remain standing after death or serve as wildlife habitat is limited in this region. Hennon and others (1984, 1990) determined how long snags of Alaska-cedar (*Chamaecyparis nootkatensis* (D. Don) Spach) persist and reported that trees that died some 80 to 100 years ago often are still standing. Long-term information is lacking for other tree species in Alaska.

From a study on Cat Island, Alaska, where trees were intentionally killed (Klein 1951) and monitored for 9 years, Embry (1963) reported the condition of dead western hemlock and western redcedar. These trees were intentionally killed in 1950 and 1951 but were not observed after 1958. We are reporting the condition of these snags 38 years after they were girdled and are comparing them with Embry's earlier observations.

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Study Area and Methods

In 1988, the site at Cat Island (near Hollis on Prince of Wales Island) in southeast Alaska, was revisited. A total of 68 individual treated trees, including 45 western hemlock, 19 western redcedar, and 4 Sitka spruce, was located on six plots. Average diameters at breast height in 1950 were 22.8, 29.4, and 37.8 inches for the tree species, respectively. Trees within the same plot received the same treatment in 1950: girdling by axe, by chainsaw and axe, or by application of poison (ammonium sulfate). We examined only trees with the first two treatments and, because the resulting girdles appeared similar, we did not compare differences by treatment. Saw and axe marks could still be seen on cedar and on some hemlock. Seven treated hemlocks on these plots could not be found.

Plots were on a relatively poor old-growth site with 10- to 30-percent slope, north aspect, and an uneven canopy of the three tree species. At Hollis, about 1 mile from plots, mean annual temperature is 44 °F and mean annual precipitation is 100 inches (Farr and Hard 1987). About 12 mature trees were originally selected for girdling on each of the 1-acre plots;[1] thus, snags were interspersed with many live, untreated trees. Information recorded for each tree found included diameter at breast height, whether bole was broken or standing, height of break (if broken), presence of primary limbs, secondary limbs, twigs, fungal species on wood, type of wood decay, percentage of bark remaining on the dead bole, and evidence of use by cavity-excavating animals. For comparison, results of snag condition are reported in the same manner as reported by Embry (1963).

Results and Discussion

Some of the trees that were presumed dead after girdling were actually alive in 1988; 3 of 45 hemlock and 9 of 19 redcedar had live foliage in 1988. Each of the surviving trees had a fluted bole (deep vertical invaginations of bark and cambium in the bole), and girdling was apparently incomplete. By the growth of cambium out of these invaginations, several of the surviving trees had regained nearly a complete circumference of live bole. Some of the trees that we observed dead in 1988 may have survived for several years or more after girdling and been dead for less than 38 years.

The condition of dead hemlock and redcedar in 1988, along with previous information from Embry's 1963 report, are given in table 1. Western hemlock deteriorates more quickly than western redcedar. All but 1 of 42 dead hemlock had boles broken at or below a height of 30 feet. All dead hemlock, both the portions of standing boles and those on the forest floor, had stages of advanced brown cubical rot or white rot, or both. Fruiting bodies of the two decay fungi, *Fomitopsis pinicola* (Schwartz:Fr.) Karst. and *Ganoderma applanatum* (Pers.:Wallr.) Pat., occurred on 47 and 31 percent of dead hemlock, respectively. The one standing dead hemlock had few primary branches and no secondary branches remaining. From the appearance of downed boles of hemlock, we inferred that snags apparently suffered one of two fates: 37 percent of snags broke at the lower bole before developing extensive decay and then decomposed on the ground, and 63 percent of snags developed decay as a standing dead tree and then shattered into many fragments upon impacting the ground. Cavities developed by birds were not observed in dead hemlock, although they may have occurred before the snags reached their current stage of decomposition.

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[1] Klein, J.A. 1951. Progress report: girdling and poisoning of live culls. U.S. Department of Agriculture, Forest Service; Silviculture, Stand Improvement Rep. RS-A1. 5 p. On file with USDA Forest Service, Forestry Sciences Laboratory, P.O. Box 20909, Juneau, AK 99802-0909.

Table 1—Condition of standing western hemlock and western redcedar 5 to 38 years after girdling at Cat Isand, Alaska[a]

	Western hemlock			Western redcedar		
Indicator[a]	Dead 5 years or less[b]	Dead 6 to 9 years[b]	38 years after girdling (n = 42)	Dead 5 years or less[b]	Dead 6 to 9 years[b]	38 years after girdling (n = 10)
Needles	Nearly gone to absent	Absent	Absent	Half gone to absent	Mostly absent	Absent
Branchlets	Partly to half gone	Half gone to nearly gone	Absent	Partly gone to absent	Half gone to absent	Absent
Secondary branches	Intact to partly gone	Partly to nearly gone	Absent	Intact to half gone	Partly to nearly gone	Absent
Primary branches	Mostly intact	Partly to half gone	Nearly gone to absent	Intact to partly gone	Partly to half gone	Half to nearly gone
Bark	Mostly intact	Mostly intact; sometimes partly gone	Nearly gone to absent	Intact	Intact to partly gone	Usually half gone to absent; intact on 1 dead cedar
Bole	Mostly intact	Intact to partly gone	Partly to nearly gone; rarely intact	Intact	Intact to partly gone	Intact to half gone
Fungi and decay		Sporophore of *Fomitopsis pinicola* and other fungi	*Fomitopsis pinicola; Ganoderma applanatum Armillaria* sp.			Decay limited to sapwood and outer heartwood

[a] Embry's (1963) indicator or adjectives:

Term	Percent absent
intact	0
partly gone	1-24
half gone	25-75
nearly gone	76-99
absent	100

[b] Results from Embry (1963).

Probably due to the decay resistance of its heartwood, western redcedar persisted longer as a dead tree than western hemlock. Six of the 10 dead redcedar remained standing in 1988, and all retained their primary branches. Three of the four downed redcedar snags broke at the girdle. Only the sapwood and outer heartwood had signs of wood decay on dead redcedar, whether standing or down. Fruiting bodies of decay fungi and cavities excavated by animals were not found on dead redcedar.

The persistence and appearance of snags of redcedar observed at Cat Island is similar to that of Alaska-cedar studied elsewhere in southeast Alaska. Snags of the latter species in a similar stage of deterioration (bole, top, and primary branches retained but secondary branches missing) have been dead an average of 51 years (Hennon and others 1984, 1990). In that length of time, the wood of hemlock and, presumably, spruce would be extensively decayed by fungi.

All four spruce occurred as standing dead boles with tops broken at an average height of 56 feet. Two of these snags were extensively used by cavity-excavating animals; one snag had 15 and the other had 21 apparent cavities.

Loose hanging bark on dead trees has been suggested as providing valuable roosting habitat for the little brown bat *(Myotis lucifugus)* (Lunde and Harestad 1986), a common resident of the forests of southeast Alaska. An average of 15 percent of the bark on hemlock, 8 percent on spruce, and 40 percent on redcedar was retained on upright boles of dead trees 38 years after girdling.

Although these data are limited in scope, they suggest that, for different reasons (hemlock does not persist for long and cedar has decay-resistant heartwood), neither small hemlock nor western redcedar snags are particularly useful for cavity excavators. Large dead spruce are apparently suitable for these animals, however. Trees with fluted boles are difficult to kill by girdling and thus may be less useful in efforts to create snags.

In a study on Admiralty Island in southeast Alaska, Hughes (1985) found bird-excavated cavities in large snags of western hemlock and Sitka spruce. Snags with broken tops were frequently used by cavity nesters, presumably because these trees contained more internal wood decay. Wood decay in trees is an essential precursor to use by cavity excavators (McClelland and Frissell 1975). Large trees that contain heartrot before they die may be particularly important to cavity-nesting birds because these trees may be used by primary excavators before and long after tree death. Persistence and condition of dead trees, associated wood decay fungi, and use by wildlife in southeast Alaska is in need of more detailed study.

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